Mathematical research using real data in the R–7 classroom

new VOICES

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takes an innovative approach to representing real data in the classroom.

The idea of using mathematical research in the classroom to collect real data has been spoken about within education for many years. But the question is, why should we bother with real data from our students' worlds and how do we actually put it into practice in the classroom?

When using the mathematical research strategy for collecting, representing and analysing real data, children are the driving force behind choosing the topics and questions for investigation. Consequently, interest and enthusiasm for learning is enhanced, as topics are about children and their own worlds (Hayden & Roberts, 1995). By forming and answering questions that are relevant to their own lives, children steer their own learning, producing new information that will potentially inform themselves, their peers and family members. In other words, the conclusions that children reach via the mathematical research strategy have the potential to provoke change in others (Bohan & Irby, 1995). Consequently, children will become aware of one of the many real world applications of mathematics: to inform others of trends, relationships and advantageous options.

As children are forming their own topics for investigation there are no limits to the number of learning areas to be covered. The integration of a number of learning areas within Mathematics and the exploring, analysing and modelling data strand of the *South Australian Curriculum Standards and Accountability Framework (DECS, 2001)* allows for ideas to be taken both wider and deeper. For example, the investigative question, 'which brand of chocolate biscuit is the best value?' can be taken both wider and deeper to include the contents and taste of the biscuit (Health), the processes undertaken to produce the biscuit (Science), a comparison of value verses taste (Mathematics), an examination and comparison of advertising strategies (S&E/Health/English), or further research into a variety of biscuit brands using the Internet (ICT).

Choosing something to investigate

The topics or questions chosen for exploration should be relevant to the children's worlds at the time of the investigation (Bobis, Mulligan, Lowrie & Taplin 1999). For example, examining data

relating to the number of Australians consuming fast food daily may not be as applicable to children as a solution to the question, "Is it possible to eat a healthy meal at any one of the major fast food outlets?" After examining the contents of a 'healthy meal', children can investigate and analyse the nutritional value of a variety of foods from fast food websites on the Internet (integrating Health, English and Mathematics). Websites for four popular fast food chains are listed (Figure 1) each of which has a comprehensive list of nutritional content.

Useful Websites:
Hungry Jacks
http://www.hungryjacks.com.au/Home.aspx
Subway
http://www.subway.com/subwayroot/index.aspx
McDonalds
http://www.mcdonalds.com.au
KFC
http://www.kfc.com

Figure 1.

Classrooms and schools provide a myriad of investigations each term, some of which will be at the direct attention of students, others that may need to be brought to their attention. For example, teachers and students may be concerned with the number of spillages occurring in the classroom and require a solution, prompting the investigative question, "Which paper towel/sponge wipes up water/cordial/yogurt most effectively?" Such a question could then be taken wider to include, which is the cheapest? And then, which is the best value to buy?

However, investigations should not only be linked to the school but to the children's home lives and wider community. For example, one teacher with whom I spoke taught Reception children, a high proportion of whom had baby siblings in their families. Consequently, this teacher guided her children in investigating, "Where does the wee go in a disposable nappy?" She then took the investigation wider to include, "Which nappy absorbs the most wee?" and finally, "Which nappy is the best value for money?" In this investigation, children were acting as data collecting and analysing consumers, who wished to be informed about the 'best buys' for their younger brothers and sisters.

I believe this idea of children acting as informed and informing consumers is a valuable place to start in choosing a topic for investigation with R-7 children. For example, most children enjoy consuming pizza. For very young children, the number of pieces of capsicum, ham or pineapple can be collated and examined to indicate the 'best buy', while older children can examine area, type and amount of ingredients, price, the time and cost of reheating (if frozen) and nutritional value. In each of these circumstances, children are acting as knowledgeable, smart consumers, a valuable skill in today's consumer-orientated society.

What does mathematical research look like in the classroom?

It is often useful to begin mathematical research with a brainstorm of issues and questions of interest to the students, either as a whole class or in small groups. Next, a question must be created, which will guide the investigation. With practice children will become better at this; however the development of a whole class question may be more effective in the first instance.

Children should then predict the outcome of the question and use this prediction to devise a method by which they will reach their conclusion. For example this could include the provision of a survey (written or oral), the collection of materials or information (e.g., searching fast food websites for the nutritional value of foods) or counting quantities (e.g., the amount of water absorbed by a paper towel or the number of pieces of capsicum on a pizza).

Children then conduct the research according to their plan, including the collection of data. It is fairly common for children to repeat this step or to modify the plan they originally prepared depending on the information obtained during the collection phase. The data collected should next be examined closely and if appropriate, a table or graph created.

Perhaps the most valuable part of the mathematical research process is in the analysis of the real data children collect and organise. At this

stage children should consider whether they have answered the question they originally set, what they have discovered from their research and finally, with whom they should share their findings. At times findings may only be shared with peers; however I believe that results should be shared with as many persons as possible to encourage children to see the authentic applications of real world mathematics.

Collecting data

With practice, children of all ages will become more confident in devising their own methods for collecting data. While more experienced children will be capable of devising and carrying out their own methods of collecting data (such as surveys or data tables), less experienced children may first benefit from whole class data collection sessions. However, if given the opportunity children will often create their own developmentally appropriate method of collecting data, including the provision of ticks and crosses or the drawing of pictures.

I have found it to be beneficial to leave the methods by which data is to be collected as open-ended as possible in the first instance. This is because the range of outcomes and answers produced allows for discussion regarding the most effective data collection strategies, including which yielded the most accurate results. Using this method, children are given the opportunity to refine their own data collection strategies via discussion and trial and error.

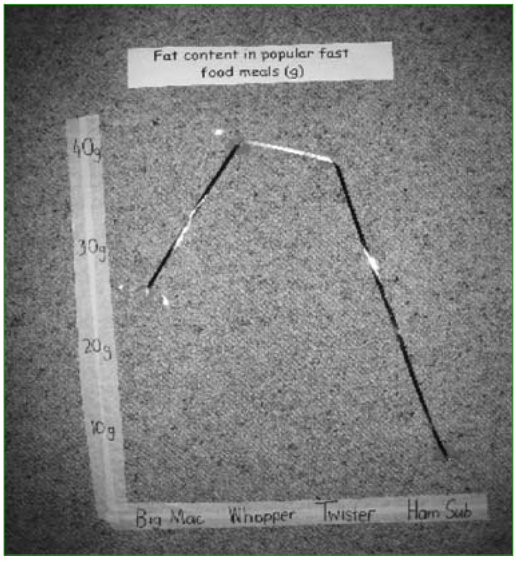

Figure 2. A large floor line graph using sticky dots, masking tape and string to represent data.

Representing data

The representation of real data collected by students is a valuable tool in highlighting one the many real world applications of mathematics: to make invisible trends and relationships visually accessible to others. In representing their data, children create an avenue by which themselves and others can examine such trends and relationships.

Bobis et al (1999) suggest that children should be given the opportunity to experiment with different methods of representing data to enhance the development of fundamental data handling skills. In doing this, an ownership of ideas and findings is promoted; further enhancing student understanding, meaning and motivation.

To reduce the abstractedness of graphs, concrete floor or people graphs can be created either as a whole class or in small groups. Some examples of these graphs include human pie graphs, 3D paper pie graphs, large floor column/bar graphs, picture graphs and line graphs (see Figure 2). Digital photos can be taken of concrete graphs for display, recording or assessment purposes (see Figure 3).

Analysing data

Children from R-7 are capable of analysing their own data, an extremely valuable experience. In analysing their own data, children realise the success of their investigation and how far they have come. They also begin to produce new information as they seek to answer their original question, an exciting experience for both teacher and student!

At this stage I find it advantageous to provide children with guiding and challenging questions to ensure that an accurate analysis of the data is obtained. As a result, most of the analysis is done

verbally. Some examples of questions I use to guide children in analysing their results are included below. However, I also encourage children to write down their analysis and findings, to aid the thinking process and to assist in the conversion of data into results.

Some examples of questions to guide children in analysing their own data:

- What do you think is happening in your graph?
- What does the shape of your graph tell us about your results?
- What does your graph tell us about (the best value pizza)? What makes you think this?
- What stands out the most for you in your data/results/graph?
- What is the most important feature of your results/graph that you would like to share with others?

To further highlight the authentic applications of collecting, representing and analysing real data,an examination of popular consumer magazines can be useful. For example, Choice magazine provides numerous examples of the analysis of data regarding a variety of different product types. In reading such texts, children can examine the methods of data representation, while considering data collection methods. Such an examination can potentially yield a whole class compilation of results, producing a Choice-type magazine.

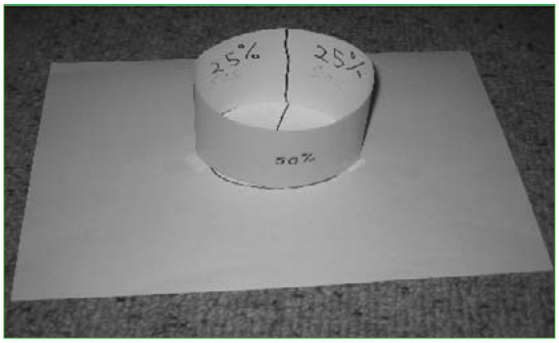

Figure 3. To create a 3-dimensional paper pie graph, draw lines to divide a strip of paper into the number of sections required to represent the data as percentages. Stick the ends of the strip together and then tape it onto an A4 piece of paper. Trace around the circular shape to create an outline of the pie graph on the A4 paper. Place a dot in the centre of the circle. Link the lines from the original strip to the centre dot. Write the original percentages in the middle of the circle. You have now created a 3D paper pie graph!

Useful Website:

Choice Magazine URL:
http://www.choice.com.au
This website includes a summary of many different consumer products and could be used as a stimulus for research topics or an example of real world mathematics.

Conclusion

In utilising the mathematical research strategy, children use mathematics for a real purpose: they create new information that assists in solving a relevant problem or issue. Via the use of real data and student driven research children are involved in the creation and formation of answers, rather than a meaningless search for them.

By using real data children are doing something useful and authentic: they are being 'real' mathematicians while creating 'real' information, to inform both themselves and others. Through engagement in mathematical research with real data, children become self-directed, motivated learners working towards a solution to an authentic dilemma, relevant to their own lives.

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At the time of writing, Naomi Darby was an education student at the University of South Australia.